

Spatial Aspects of Pedogenesis and Soil Organic Carbon in the Great Lakes Region - Barrett

Objectives:

The research activities at Sleeping Bear Dunes National Lakeshore are part of a larger research project funded by the National Science Foundation. The activities for the larger project are designed to elucidate the geography of podzolization processes in the upper Great Lakes region using a functional, factorial approach (Jenny 1941), and also to examine the mechanisms by which podzolization/depodzolization take place. Specifically, the objectives of the proposed research activities are: (1) To investigate and quantify rates of podzolization in sand-textured soils of the Great Lakes region, with an emphasis on accumulation of B horizon organic carbon, and to study how those rates vary with climate across the region; (2) To examine the dynamics of organic carbon in the podzol B horizon, especially its response to long-term forest disturbance and its role in the possible degradation of that horizon (depodzolization); and (3) To study the mechanisms of iron, aluminum, and organic carbon translocation in Great Lakes podzols, and how those mechanisms are affected by the soil-forming factors of time, climate, and organisms. Research plan To meet these varied objectives, I have followed a three-pronged approach, with three separate but related research projects. The research projects are: (1) a chronosequence study, in which rates of podzolization are studied by sampling soils in four detailed age sequences in similar parent material types and contrasting climates; (2) a soil solution study, in which soil solutions are sampled and monitored over time in order to study the mobility of ions under both natural and cultivated vegetation and at various stages of soil development; and (3) a carbon isotope study, in which accelerator mass spectrometer (AMS) techniques are used to investigate carbon dynamics of podzol B horizons under a variety of vegetation and soil development conditions. The activities at Sleeping Bear National Lakeshore include activities related to all three of these objectives during the course of the study. During the year 2002, however, only the soil solution study required activity within the park. (Analysis of samples from previous years is still on-going, however.)

Findings and Status:

Sampling for the chronosequence study and the carbon isotope study was completed during the summers of 2000 and 2001. Soils were sampled on approximately 20 ridges of different, known ages, ranging from about 1000 years to about 3000 years in age. Soils were sampled by horizon (approximately 6 or 7 horizons were sampling site). The soil samples are currently undergoing analysis for extractable iron, aluminum, and organic carbon content. To date, results of oxalate-extractable iron and aluminum content and organic carbon content of these samples are essentially complete. Currently citrate-dithionite extractable iron and aluminum content analyses are under way. In addition, about 20 samples from four sampling sites were sent for AMS radiocarbon dating. Most of these analyses are now complete, although a few results have not yet been received from the laboratory. Activities in the park during 2002 were limited to periodically retrieving soil solution samples from the set of soil solution samplers that was installed at a single location during the summer of 2001. The process of

retrieving the samples consists of applying a vacuum to the sampler with a hand pump in the evening, and then returning the following morning to retrieve the sample that has collected overnight. The samplers (which consist of a ceramic cup at the bottom of a sealed 2" PVC pipe of varying length, installed in the soil) remain in place in between sampling intervals. The soil solution collected in this manner (samples were retrieved in April, June, August, and October during 2002) are analyzed for a variety of common cations, including iron, aluminum, sodium, and potassium. pH measurements are also obtained. The analysis is completed as soon as possible after sampling is finished.